

E 1.28. SOLAR /2017 - 79 /04

✓
H/eph. 12/54/78

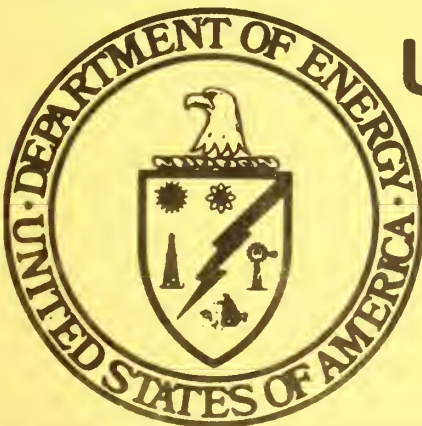
SOLAR/2017-79/04



Monthly Performance Report

ALABAMA POWER COMPANY

APRIL 1979



U.S. Department of Energy

National Solar Heating and
Cooling Demonstration Program

National Solar Data Program

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

MONTHLY PERFORMANCE REPORT
ALABAMA POWER COMPANY
APRIL 1979

I. SYSTEM DESCRIPTION

The Alabama Power Company solar energy site is a two and one-half story commercial office building located in Montevallo, Alabama. The building has a floor area of approximately 17,000 square feet. The solar energy system is designed to provide 57 percent of the annual domestic hot water and space heating demands and up to 18 percent of the annual space cooling demand.

The collector subsystem includes four rows of flat-plate double glazed collectors. The gross area of the collectors is 2,340 square feet. The collectors are supplemented by two types of reflectors. The rear three rows of the collectors have facing mirrors sloped at 45 degrees from the horizontal while the collectors are sloped at 30 degrees from the horizontal, facing south. All four rows of collectors have vertical mirrors mounted at the tops of the collector frames. The total area of the sloped reflectors is 2,250 square feet and the total area of the vertical reflectors is 740 square feet. The collection transport fluid is water and a drain-down method of freeze protection is used. An 8,000 gallon tank is used to store solar energy.

Domestic hot water (DHW) preheating is accomplished by means of a heat exchanger tube passing through the solar storage tank. Solar preheating is supplemented, as required, by a 120-gallon electric water heater.

There are seven independently controlled heating/cooling zones. Each zone is supplied by its own air-handling unit. The air-handling units have both hot and cold water lines to allow each unit to be used and controlled independently of the other six parallel units.

Space heating is provided by pumping water from the solar storage tank through heating coils in the air-handling units. The water from solar storage is passed through an electric auxiliary boiler prior to entering the coils of the air-handling units. If the water temperature in the

solar storage tank is too low to meet the heating demand, the electric boiler is used to provide additional heating to the water, as required.

Solar energy used in cooling is provided by passing water directly from the collectors to the generator section of a 25-ton absorption chiller. Auxiliary cooling is provided by a 30-ton electric reciprocating chiller which is used in parallel with the absorption machine. An 8,000-gallon chilled water storage tank is also included in the system. This chilled water storage tank can be supplied by the absorption machine or by the reciprocating chiller during off-peak hours.

The system, shown schematically in Figure 1, has four modes of solar operation.

Mode 1 - Collector to Storage: This mode is enabled by a time clock during daylight hours and it is entered when the temperature of the water at the collector outlet exceeds the temperature of the water in the solar storage tank by approximately 10°F. This temperature differential is adjustable and is to be adjusted for optimum performance based on operational experience. The mode is terminated when the collector outlet temperature no longer exceeds the storage tank temperature by the adjusted value or when the time clock disables the mode logic.

Mode 2 - Collector to Cooling: This mode is entered out of Mode 1 when the collector outlet water temperature reaches or exceeds 165°F. Water from the collectors is diverted directly to the generator section of the absorption chiller before returning to solar storage. Evaporator outlet water is passed to the cooling coils in the air handlers whenever a cooling demand exists. If no cooling demand exists during this mode, the chilled water from the absorption machine passes into the chilled water storage tank. In this mode, the adsorption machine functions in parallel with the electric chiller to supply the building cooling load. Since heating and cooling are independently controlled by each zone, it is possible to have this mode and Mode 3 active simultaneously. The mode is terminated when the absorption machine generator inlet water temperature drops to 157°F.

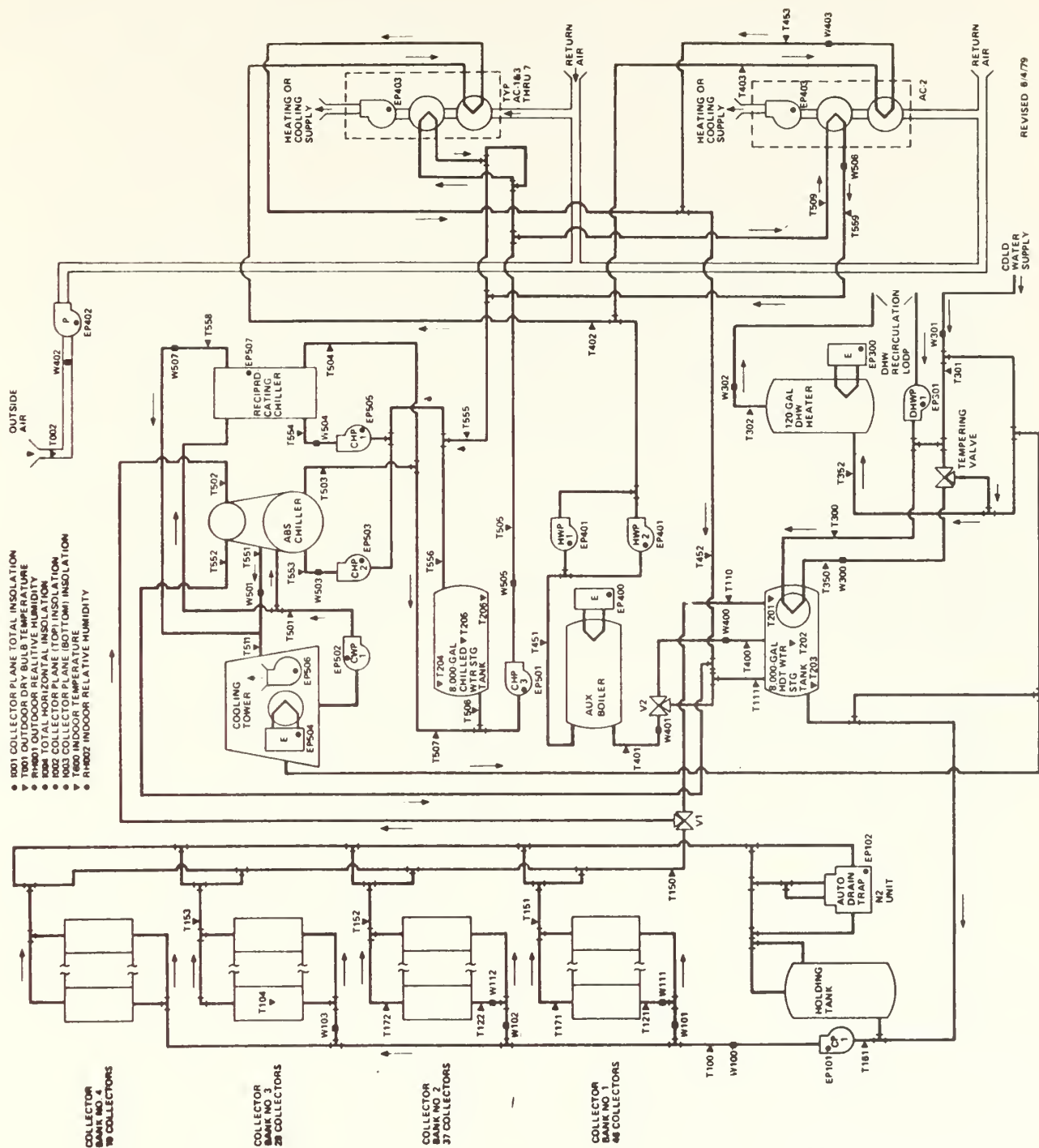


Figure 1. ALABAMA POWER SOLAR ENERGY SYSTEM SCHEMATIC

Mode 3 - Storage to Space Heating: This mode is initiated when a demand for space heating occurs at any of the independently controlled heating/cooling zones or when the outdoor air temperature drops below 65°F. Water from the solar storage tank is pumped through the auxiliary boiler, out to the air handling units and returned to storage. If the temperature of the water in the solar storage tank is above the limit value of 140°F, blending of solar storage water and space heating return water occurs to maintain a boiler inlet water temperature below 140°F. The minimum control temperature for space heating supply is varied with outside air temperature. When the outside air temperature is 65°F, the minimum space heating water temperature is 80°F. When the outside air temperature is 25°F, the minimum space heating water temperature is 120°F. The boiler is activated, as required, to maintain the minimum space heating temperature according to the control temperature just described. If the solar storage tank temperature is below the temperature of the space heating return water, the solar storage tank is bypassed by the return water. This mode can be active simultaneously with Mode 2 since heating and cooling demands are independently determined by each of the heating/cooling zones.

Mode 4 - DHW Preheating: This mode is accomplished independently of the other three solar modes. Incoming city (makeup) water and recirculation return water are passed through a U-tube heat exchanger in the solar storage tank when the temperature of the water in storage exceeds the DHW heat exchanger inlet water temperature. From the heat exchanger the water returns to the 120-gallon DHW tank which contains an electric auxiliary heating element to supplement the solar preheat. Water from the DHW tank is continuously recirculated through the building's hot water lines and returned to the DHW tank via the heat exchanger or directly.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data.

The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The Alabama Power Company solar energy site was in operation during the entire month of April. The solar energy system supplied approximately 17 percent of the combined loads for DHW, space heating and space cooling. Space cooling was the primary load for the month but none of this load was supported by solar energy since the solar heated water was not hot enough to support absorption cooling.

B. Weather

The average ambient temperature for April was 63°F with an average daytime ambient temperature of 66°F. The long-term average temperature for April is 63°F for the Birmingham, Alabama area. With these mild temperatures, the heating and cooling loads are expected to be small for April. The total incident insolation on the collector array was 102.7 million Btu for an average of 1,415 Btu/ft²-day. This was below the April average of 1,834 Btu/ft²-day derived from long-term data for the Birmingham area.

C. System Thermal Performance

Collector - Of the 102.7 million Btu of solar energy incident upon the collector array during April, 39.77 million Btu were incident when the collector pump (CPI) was operating. The system produced a net collection of 13.00 million Btu, which was 13 percent of the total incident radiation. The net collection of 13.00 million Btu was the result of 15.22 million Btu measured gain through the collectors reduced by a measured rejection of 2.31 million Btu. The relatively high level of energy rejection through the collectors was the result of frequent operation of the collector pump at times when insolation was too low for collection. The operating energy (collector pump power) for the collector subsystem was 1.54 million Btu during April.

Energy Collection and Storage Subsystem - The energy collection and storage subsystem (ECSS) includes the collector array, the solar storage tank and the lines connecting these elements to each other. The ECSS is connected to the load subsystems by supply and return lines. Figure 2 illustrates the ECSS and its energy flow paths. The net input to the ECSS through the collectors was 12.91 million Btu (15.22 million Btu collected, less 2.31 million Btu rejected). The output from the ECSS to the load subsystem connecting lines was 3.89 million Btu. Therefore, the total loss of energy from the connecting lines and solar storage tank was 6.92 million Btu.

Storage - The measured input to the solar storage tank was 15.22 million Btu while solar energy was being collected. The total measured output from the solar storage tank was 6.27 million Btu. The measured temperature in the solar storage tank indicated an increase of 2.10 million Btu in stored energy for the month. Therefore, the calculated loss through the walls of the storage tank was 6.85. This leaves 0.07 million Btu in ECSS line losses to make up the remainder of the 6.92 million Btu total ECSS losses.

Domestic Hot Water Load - The DHW load calculation is based on the flow through the DHW heat exchanger and the temperature difference between the outlet and inlet of the DHW heat exchanger plus the auxiliary electrical energy input to the DHW heater tank. The average temperature maintained at the DHW tank outlet was 103°F during April. Due to collector damage during the winter the recirculation pump EP300, which normally runs continuously, was shut off for April. This was done to prevent thermal siphoning from the 120-gallon DHW tank. Also, pump EP300 was turned on periodically to heat the water in the DHW tank. Consequently, of the 0.93 million Btu DHW load, only 15 percent, or 0.14 million Btu, was supplied by solar energy.

Space Heating Load - The total measured space heating load for April was 5.25 million Btu, of which 3.56 million Btu, or 68 percent, were supplied by solar energy. The remaining 1.69 million Btu were supplied by the

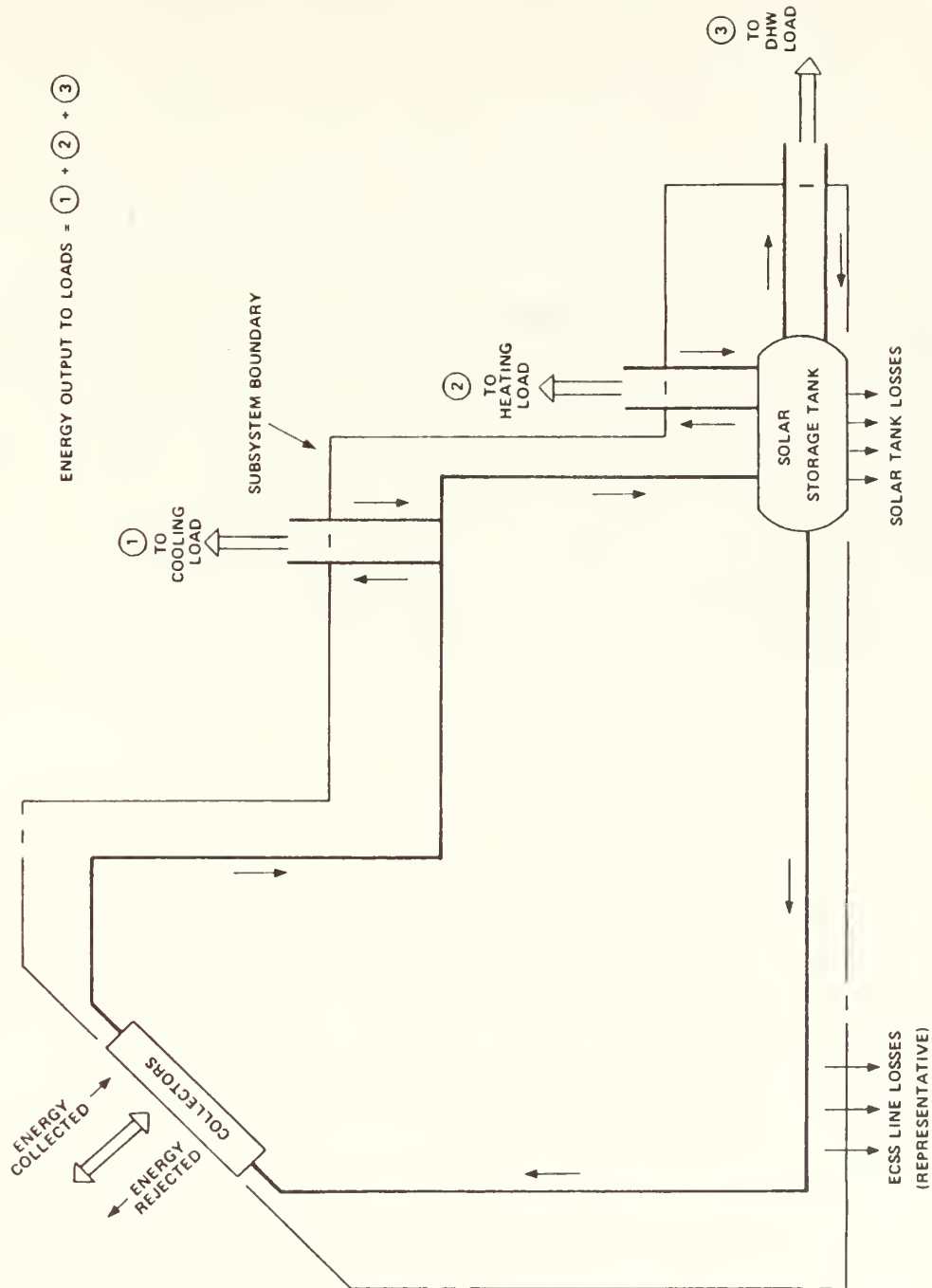


Figure 2. ALABAMA POWER COMPANY ECSS ENERGY FLOW SCHEMATIC

electric boiler. The total operating energy for the space heating subsystem was 1.07 million Btu of which 0.10 million Btu were charged directly to the solar energy system. The operating energy charged directly to the solar energy system was the pro-rata share of the circulation pump (HWP1, HWP2) power required to circulate the heated water through the space heating subsystem. Power to operate the air-handler fans was not charged against solar energy since that power would have been required regardless of whether a conventional or solar energy system was used.

Space Cooling Load - The total space cooling load for April was 42.81 million Btu. A negligible amount of this load was supported by solar energy due to the low temperature of the solar heated water available at the absorption chiller generator inlet. The absorption chiller was active on one day for a short period of time and the operating energy for space cooling charged to the solar energy system was 0.002 million Btu. The operation of the auxiliary electric chiller is summarized in the table entitled "Auxiliary Thermodynamic Conversion Equipment."

D. Observations

A significant penalty was imposed on the solar energy system by the high percentage of energy rejected through the collectors. Due to the damaged collectors, the space heating mode of solar energy system suffered considerably, along with the space cooling mode, since the water temperature in the storage tank was not raised sufficiently to supply either need. Control system improvements and basic repairs are needed to optimize solar energy collection and minimize rejection of energy through the collectors.

The seemingly high energy losses in the hot water storage tank are due to two factors. The first is the expected losses from the tank with two inches of polyurethane insulation. This calculates to be approximately 3.3 million Btu. Secondly, due to the placement of the collector control

sensor, collector pumps were activated every half-hour in the morning to determine an accurate collector outlet temperature. During the course of the month, this resulted in a rejection of approximately 3.5 million Btu of energy from the storage tank.

E. Energy Savings

A total electrical savings of 2.01 million Btu was calculated for the Alabama Power Company solar energy system. The savings calculations for DHW and space heating are based on the assumption that all load support provided by solar energy would have been provided by an equal amount of electrical energy. This load support is reduced by the amount of operating energy charged to solar hot water heating and solar space heating. The space cooling savings are calculated by obtaining the quotient of the load supplied by the absorption chiller divided by the coefficient of performance of a typical electric chiller (2.8) and subtracting the operating energy charged to solar (absorption) cooling. The total system savings is then calculated by summing the subsystem savings and reducing that sum by the amount of operating energy required by the ECSS.

III. ACTION STATUS

None.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1978

SOLAR/2017-79/04

SITE/SYSTEM DESCRIPTION:

ALABAMA POWER SOLAR SYSTEM PROVIDES SUPPORT TO SPACE HEATING, SPACE COOLING AND DOMESTIC HOT WATER SYSTEMS. SOLAR HEATED WATER IS UTILIZED TO DRIVE AN ABSORPTION CHILLER WHICH ASSISTS AN ELECTRIC POWERED CHILLER IN PROVIDING SYSTEM COOLING WATER. HEATED WATER FOR SUPPORTING SPACE HEATING AND DOMESTIC HOT WATER IS STORED IN AN 8000 GALLON CAPACITY TANK. THE DOMESTIC HOT WATER CONTINUOUS RECIRCULATION LOOP INCLUDES FLOW THROUGH A HEAT EXCHANGER LOCATED INSIDE THE STORAGE TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY
COLLECTED SOLAR ENERGY

102.658 MILLION BTU
42871 RTU/50.0 FT.
12.987 MILLION BTU
5550 BTU/50.0 FT.
63 DEGREES F
77 DEGREES F
0.04
1.537 MILLION BTU
67.602 MILLION BTU
95.257 MILLION BTU

AVERAGE AMBIENT TEMPERATURE
AVERAGE BUILDING TEMPERATURE
ECS SOLAR CONVERSION EFFICIENCY
ECS OPERATING ENERGY
TOTAL SYSTEM OPERATING ENERGY
TOTAL ENERGY CONSUMED

SUBSYSTEM SUMMARY:

LOAD
SOLAR FRACTION USED
OPERATING ENERGY
AUX. THERMAL ENERGY
AUX. ELECTRIC FUEL
AUX. FOSSIL FUEL
ELECTRICAL SAVINGS
FOSSIL SAVINGS

HOT WATER
0.034
0.135
0.084
0.703
0.793
N.A.
0.135
N.A.

HEATING
5.254
3.561
1.072
1.653
1.707
N.A.
3.464
N.A.

COOLING
42.812
0.002
64.845
0.005
12.865
N.A.
0.000
N.A.

SYSTEM TOTAL
49.383 MILLION BTU
8 PERCENT
3.883 MILLION BTU
67.692 MILLION BTU
11.344 MILLION BTU
15.281 MILLION BTU
N.A. MILLION BTU
2.006 MILLION BTU
N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR:

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/19

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SITE SUMMARY

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1979

SOLAR/2017-79/04

SITE/SYSTEM DESCRIPTION:

ALABAMA POWER SOLAR SYSTEM PROVIDES SUPPORT TO SPACE HEATING, SPACE COOLING AND DOMESTIC HOT WATER SYSTEMS. SOLAR HEATED WATER IS UTILIZED TO DRIVE AN ABSORPTION CHILLER WHICH ASSISTS AN ELECTRIC POWERED CHILLER IN PROVIDING SYSTEM COOLING WATER. HEATED WATER FOR SUPPORTING SPACE HEATING AND DOMESTIC HOT WATER IS STORED IN AN 8000 GALLON CAPACITY TANK. THE DOMESTIC HOT WATER CONTINUOUS RECIRCULATION LOOP INCLUDES FLOW THROUGH A HEAT EXCHANGER LOCATED INSIDE THE STORAGE TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	108.304	GIGA JOULES
COLLECTED SOLAR ENERGY	408201	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	13.701	GIGA JOULES
AVERAGE BUILDING TEMPERATURE	63026	KJ/SQ.M.
ECSS SOLAR CONVERSION EFFICIENCY	17	DEGREES C
ECSS OPERATING ENERGY	25	DEGREES C
TOTAL SYSTEM OPERATING ENERGY	0.04	GIGA JOULES
TOTAL ENERGY CONSUMED	1.621	GIGA JOULES
	71.415	GIGA JOULES
	100.406	GIGA JOULES

SUBSYSTEM SUMMARY:

LOAD	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
SOLAR FRACTION USED	0.085	5.543	45.167	52.099
SOLAR ENERGY USED	15	68	0.007	8
OPERATING ENERGY	0.142	3.757	0.411	4.007
AUX. THERMAL ENG	0.089	1.131	68.411	71.415
AUX. ELECTRIC FUEL	0.827	1.786	0.500	11.068
AUX. FOSSIL FUEL	0.837	1.801	13.572	16.121
AUX. ELECTRICAL SAVINGS	N.A.	N.A.	N.A.	N.A.
FOSSIL SAVINGS	0.142	3.654	0.000	2.116
	N.A.	N.A.	N.A.	N.A.

SYSTEM PERFORMANCE FACTOR:

0.179

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: ALARAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1979

SOLAR/2017-70/04

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	2.937	69	0.030	NCT	0.000	NCT	0.010
2	0.736	67	0.035		0.000		0.048
3	2.786	60	0.046		0.000		0.016
4	3.056	62	0.092		0.034		0.030
5	5.638	55	0.036		0.113		0.006
6	5.434	57	0.548		0.080		0.106
7	5.149	62	0.000		0.012		0.000
8	1.036	57	0.000		0.000		0.000
9	4.214	60	0.000		0.108		0.000
10	4.221	55	1.050		0.117		0.000
11	2.889	73	0.000		0.114		0.000
12	0.268	64	0.000		0.035		0.000
13	1.436	64	0.000		0.055		0.000
14	5.636	61	0.000		0.004		0.000
15	5.450	62	0.001		0.000		0.000
16	4.701	61	0.297		0.000		0.000
17	4.987	65	0.000		0.036		*
18	4.671	67	*		*		*
19	4.028	68	0.000		0.061		0.000
20	4.832	67	0.003		0.116		0.001
21	1.075	66	0.000		0.000		0.000
22	1.607	67	0.000		0.002		0.000
23	1.633	67	0.000		0.102		0.000
24	1.071	64	0.001		0.112		0.001
25	0.820	62	0.000		0.055		0.000
26	2.946	66	0.000		0.118		0.000
27	5.072	58	0.198		0.110		0.030
28	5.211	57	0.561		0.004		0.108
29	3.917	55	0.755		0.002		0.103
30	5.193	63	0.112		0.116		0.022
SUM	102.658	-	3.893	N.A.	1.537	N.A.	-
AVG	3.422	63	0.130	N.A.	0.051	N.A.	0.038
NBS ID	0001	N113			0102		N111

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SCLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT COLLECTOR ARRAY PERFORMANCE

SITE: ALARAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-79/04
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	INCIDENT SCLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SCLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	2.937	0.000	0.000	71	0.000
2	0.736	0.000	0.000	69	0.000
3	2.786	0.000	0.000	57	0.000
4	3.056	0.000	0.000	66	0.167
5	5.638	0.745	0.511	68	0.404
6	5.434	2.969	1.168	67	0.215
7	5.140	0.000	0.000	71	0.000
8	1.036	0.000	0.000	54	0.000
9	4.214	3.432	0.840	61	0.199
10	4.221	3.811	0.950	59	0.225
11	2.888	2.528	0.199	76	0.069
12	0.268	0.005	0.000	61	0.000
13	1.436	0.000	0.171	64	0.119
14	5.450	0.000	0.000	65	0.000
15	4.701	0.000	0.000	71	0.000
16	4.987	0.000	0.000	*	0.000
17	4.671	0.000	0.000	74	0.000
18	4.028	0.123	2.204	73	0.472
19	4.822	0.881	-0.043	*	-0.011
20	4.075	4.424	1.476	75	0.306
21	1.607	0.001	0.000	70	0.000
22	1.633	1.341	-0.344	*	-0.210
23	1.071	0.830	-0.540	68	-0.504
24	0.829	0.359	-0.206	64	-0.280
25	2.946	2.709	0.826	62	0.307
26	5.072	4.628	1.555	70	0.000
27	5.211	0.000	0.000	61	0.000
28	3.017	0.000	0.000	60	0.000
29	5.103	4.845	1.940	70	0.374
SUM	102.658	29.770	12.987	-	-
AVG	3.422	1.326	0.433	66	0.127
NBSID	0001		0100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT STORAGE PERFORMANCE

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1979
SOLAR/2017-70/04

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.000	0.030	-0.004	101	1.000
2	0.000	0.035	-0.001	99	1.000
3	0.000	0.046	-0.008	98	1.000
4	0.566	0.147	-0.005	96	0.197
5	2.270	0.037	1.818	108	0.814
6	2.215	0.400	0.178	124	0.550
7	0.000	0.000	0.340	120	1.000
8	0.000	0.000	-0.556	124	1.000
9	0.861	0.020	0.517	124	0.625
10	1.206	1.306	-0.030	130	1.058
11	0.432	0.234	-0.085	131	0.344
12	0.000	0.000	-1.016	123	1.000
13	0.227	0.056	-0.244	112	-0.826
14	0.000	0.000	-0.070	111	1.000
15	0.000	0.001	-0.251	110	1.000
16	0.000	0.297	-0.203	107	1.000
17	0.000	0.000	-0.252	106	1.000
18	2.204	0.379	1.205	116	0.719
19	0.068	0.111	-0.432	126	-0.745
20	1.557	0.084	1.272	131	-0.871
21	0.000	0.000	-0.210	141	1.000
22	0.000	0.000	-0.607	137	1.000
23	0.000	0.381	-0.753	124	-0.986
24	0.000	0.541	-0.708	113	1.000
25	0.000	0.206	-0.665	104	1.000
26	0.981	0.154	0.752	103	0.624
27	1.637	0.279	1.290	117	0.959
28	0.000	0.561	-0.316	126	1.000
29	0.000	0.755	-0.688	116	1.000
30	1.048	0.120	1.474	121	0.818
SUM	15.210	6.269	2.009	-	-
AVG	0.507	0.209	0.070	117	0.550
NBS ID	0200	0201	0202		N108

* DENOTES UNAVAILABLE DATA.
 @ DENOTES NULL DATA.
 N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM
MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1979
APRIL 2017-79/04

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR. OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX FUEL MILLION BTU	AUX FUEL MILLION BTU	FLECT ENERGY SAVINGS MILLION RTU	FOSSIL ENERGY SAVINGS MILLION RTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.030	100	0.030	0.023	0.000	0.000	0.000	0.030	NCT	NCT	97	NCT
2	0.034	100	0.034	0.023	0.000	0.000	0.000	0.034	NCT	NCT	96	NCT
3	0.046	100	0.046	0.023	0.000	0.000	0.000	0.046	NCT	NCT	94	NCT
4	0.064	124	0.009	0.016	0.048	0.048	0.000	0.009	APPLICABLE	APPLICABLE	99	APPLICABLE
5	0.034	0	0.000	0.000	0.034	0.034	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
6	0.025	0	0.000	0.000	0.025	0.025	0.000	0.000	APPLICABLE	APPLICABLE	105	APPLICABLE
7	0.019	0	0.000	0.000	0.019	0.019	0.000	0.000	APPLICABLE	APPLICABLE	105	APPLICABLE
8	0.021	0	0.000	0.000	0.021	0.021	0.000	0.000	APPLICABLE	APPLICABLE	104	APPLICABLE
9	0.026	0	0.000	0.000	0.026	0.026	0.000	0.000	APPLICABLE	APPLICABLE	105	APPLICABLE
10	0.025	0	0.000	0.000	0.025	0.025	0.000	0.000	APPLICABLE	APPLICABLE	105	APPLICABLE
11	0.022	0	0.000	0.000	0.022	0.022	0.000	0.000	APPLICABLE	APPLICABLE	104	APPLICABLE
12	0.030	0	0.000	0.000	0.030	0.030	0.000	0.000	APPLICABLE	APPLICABLE	108	APPLICABLE
13	0.050	0	0.000	0.000	0.050	0.050	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
14	0.036	0	0.000	0.000	0.036	0.036	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
15	0.038	0	0.000	0.000	0.037	0.037	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
16	0.031	0	0.000	0.000	0.036	0.036	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
17	0.027	0	0.000	0.000	0.028	0.028	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
18	0.027	0	0.000	0.000	0.027	0.027	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
19	0.018	15	0.003	0.000	0.015	0.015	0.000	0.003	APPLICABLE	APPLICABLE	104	APPLICABLE
20	0.024	0	0.000	0.000	0.024	0.024	0.000	0.000	APPLICABLE	APPLICABLE	104	APPLICABLE
21	0.019	0	0.000	0.000	0.019	0.019	0.000	0.000	APPLICABLE	APPLICABLE	99	APPLICABLE
22	0.027	0	0.000	0.000	0.027	0.027	0.000	0.000	APPLICABLE	APPLICABLE	93	APPLICABLE
23	0.034	0	0.000	0.000	0.035	0.035	0.000	0.000	APPLICABLE	APPLICABLE	105	APPLICABLE
24	0.040	0	0.000	0.000	0.034	0.034	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
25	0.026	0	0.000	0.000	0.040	0.040	0.000	0.000	APPLICABLE	APPLICABLE	107	APPLICABLE
26	0.019	17	0.003	0.000	0.026	0.026	0.000	0.000	APPLICABLE	APPLICABLE	106	APPLICABLE
27	0.034	11	0.004	0.000	0.016	0.016	0.000	0.003	APPLICABLE	APPLICABLE	105	APPLICABLE
28	0.024	0	0.000	0.000	0.031	0.031	0.000	0.004	APPLICABLE	APPLICABLE	105	APPLICABLE
29	0.034	0	0.000	0.000	0.024	0.024	0.000	0.000	APPLICABLE	APPLICABLE	105	APPLICABLE
30	0.024	0	0.000	0.000	0.024	0.024	0.000	0.000	APPLICABLE	APPLICABLE	105	APPLICABLE
SUM	0.934	-	0.135	0.084	0.793	0.793	N.A.	0.135	N.A.	-	-	N.A.
AVG	0.031	15	0.004	0.003	0.026	0.026	N.A.	0.004	N.A.	N.A.	103	N.A.
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SPACE HEATING SUBSYSTEM

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1979
SOLAR/2017-79/04

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR. OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	EL FCT ENERGY SAVINGS MILLION BTU	FOSSYL ENERGY SAVINGS MILLION BTU	PLNG TEMP DEG. F	AMR TEMP DEG. F
1	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	77	69
2	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	67
3	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	67
4	0.083	100	0.083	0.015	0.000	0.000	NOT	0.083	NOT	75	62
5	0.860	104	0.492	0.130	0.833	0.834	NOT	0.035	NOT	75	57
6	0.606	81	0.000	0.041	0.114	0.114	NOT	0.486	NOT	75	57
7	0.051	0	0.000	0.000	0.051	0.051	NOT	0.000	NOT	70	62
8	0.026	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	77	57
9	1.102	95	0.000	0.029	0.026	0.026	NOT	0.000	NOT	75	60
10	0.000	0	1.050	0.133	0.052	0.052	NOT	1.038	NOT	76	55
11	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	64
12	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	64
13	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	64
14	0.028	0	0.000	0.020	0.000	0.000	NOT	0.000	NOT	78	61
15	0.025	0	0.000	0.025	0.025	0.025	NOT	0.000	NOT	76	61
16	0.677	42	0.283	0.035	0.394	0.394	NOT	0.278	NOT	*	65
17	0.023	0	0.000	*	0.023	0.023	NOT	0.000	NOT	*	67
18	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	*	67
19	0.032	0	0.000	0.018	0.000	0.000	NOT	0.000	NOT	76	67
20	0.000	0	0.000	0.000	0.032	0.032	NOT	0.000	NOT	76	67
21	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	79	66
22	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	77	67
23	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	64
24	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	62
25	0.000	0	0.000	0.000	0.000	0.000	NOT	0.000	NOT	76	62
26	0.308	64	0.198	0.100	0.111	0.122	NOT	0.000	NOT	77	66
27	0.559	100	0.557	0.101	0.002	0.002	NOT	0.186	NOT	78	57
28	0.751	100	0.751	0.164	0.000	0.000	NOT	0.540	NOT	78	55
29	0.115	97	0.112	0.068	0.003	0.003	NOT	0.715	NOT	77	62
30	5.254	-	3.561	1.072	1.693	1.707	NOT	3.105	NOT	-	-
SUM	0.175	68	0.119	0.036	0.056	0.057	N.A.	3.464	N.A.	-	-
AVG	Q402	N400	Q400	Q403	Q401	Q405	Q410	Q415	Q417	77	63
NBS										N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT SPACE COOLING SUBSYSTEM

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1979
SOLAR/2017-79/04

DAY OF MON.	SPACE COOLING LOAD MILLION BTU	SOLAR FR. OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION RTU	AUX FOSSIL FUEL MILLION RTU	ELECT ENERGY SAVINGS MILLION RTU	FOSSIL ENERGY SAVINGS MILLION RTU	BLDG DRY BULB TEMP F	AMR TEMP DEG F
1	0.000	0	0.000	1.358	0.000	0.000	0.000	0.000	0.000	80	69
2	2.683	0	0.000	2.371	0.571	0.815	0.000	0.000	0.000	77	67
3	1.826	0	0.000	2.371	0.420	0.599	0.000	0.000	0.000	76	60
4	1.826	0	0.000	2.385	0.416	0.594	0.000	0.000	0.000	76	62
5	1.887	0	0.000	2.322	0.411	0.588	0.000	0.000	0.000	75	55
6	1.912	0	0.000	2.361	0.426	0.608	0.000	0.000	0.000	75	57
7	0.000	0	0.000	1.637	0.000	0.000	0.000	0.000	0.000	78	62
8	0.000	0	0.000	1.637	0.000	0.000	0.000	0.000	0.000	79	57
9	1.844	0	0.000	2.297	0.360	0.527	0.000	0.000	0.000	77	60
10	2.092	0	0.000	2.362	0.448	0.640	0.000	0.000	0.000	75	55
11	3.090	0	0.000	2.561	0.579	0.828	0.000	0.000	0.000	76	73
12	2.140	0	0.000	2.544	0.487	0.696	0.000	0.000	0.000	76	64
13	2.140	0	0.000	2.336	0.415	0.598	0.000	0.000	0.000	76	64
14	1.891	0	0.000	1.637	0.000	0.000	0.000	0.000	0.000	78	61
15	0.000	0	0.000	1.637	0.000	0.000	0.000	0.000	0.000	79	62
16	0.000	*	*	*	*	*	*	*	*	*	15
17	0.000	*	*	*	*	*	*	*	*	*	15
18	0.000	*	*	*	*	*	*	*	*	*	15
19	2.264	0	0.000	2.682	0.488	0.656	0.000	0.000	0.000	76	68
20	2.406	0	0.000	2.409	0.471	0.672	0.000	0.000	0.000	76	67
21	0.000	0	0.000	1.637	0.000	0.000	0.000	0.000	0.000	79	66
22	0.697	0	0.000	1.798	0.207	0.296	0.000	0.000	0.000	79	67
23	0.536	0	0.000	2.547	0.532	0.760	0.000	0.000	0.000	77	67
24	2.541	0	0.000	2.653	0.550	0.785	0.000	0.000	0.000	76	64
25	1.672	0	0.000	2.313	0.393	0.562	0.000	0.000	0.000	76	62
26	1.659	0	0.000	2.379	0.000	0.000	0.000	0.000	0.000	76	66
27	1.109	0	0.000	2.387	0.191	0.273	0.000	0.000	0.000	77	58
28	0.000	0	0.000	1.637	0.000	0.000	0.000	0.000	0.000	78	57
29	0.000	0	0.000	1.637	0.000	0.000	0.000	0.000	0.000	78	55
30	2.453	0	0.000	2.568	0.728	1.040	0.000	0.000	0.000	77	63
SUM	42.812	-	0.092	64.845	9.005	12.865	N.A.	0.000	N.A.	-	-
AVG	1.427	0	0.003	2.161	0.300	0.429	N.A.	0.003	N.A.	77	63
NBS	Q502	N500	Q500	Q503	Q501		Q508	Q512	Q514	N406	N113

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT ENVIRONMENTAL SUMMARY

SOLAR/2017-79/04

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ. FT	DIRECT INSOLATION BTU/SQ. FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1255	NOT	69	71	NOT	NOT	NOT
2	315	NOT	67	69	NOT	NOT	NOT
3	1191	NOT	60	57	NOT	NOT	NOT
4	1306	NOT	62	66	NOT	NOT	NOT
5	2409	NOT	55	58	NOT	NOT	NOT
6	2322	NOT	57	67	NOT	NOT	NOT
7	2200	NOT	62	71	NOT	NOT	NOT
8	443	NOT	57	54	NOT	NOT	NOT
9	1801	NOT	55	50	NOT	NOT	NOT
10	1804	NOT	55	50	NOT	NOT	NOT
11	1235	NOT	73	76	NOT	NOT	NOT
12	1115	NOT	64	61	NOT	NOT	NOT
13	614	NOT	61	64	NOT	NOT	NOT
14	2409	NOT	61	65	NOT	NOT	NOT
15	2329	NOT	62	71	NOT	NOT	NOT
16	2009	NOT	61	71	NOT	NOT	NOT
17	2131	NOT	65	74	NOT	NOT	NOT
18	1996	NOT	67	73	NOT	NOT	NOT
19	1722	NOT	68	75	NOT	NOT	NOT
20	2065	NOT	67	70	NOT	NOT	NOT
21	459	NOT	66	70	NOT	NOT	NOT
22	687	NOT	67	68	NOT	NOT	NOT
23	698	NOT	67	68	NOT	NOT	NOT
24	458	NOT	64	64	NOT	NOT	NOT
25	354	NOT	62	62	NOT	NOT	NOT
26	1259	NOT	66	70	NOT	NOT	NOT
27	2167	NOT	58	62	NOT	NOT	NOT
28	2227	NOT	57	61	NOT	NOT	NOT
29	1674	NOT	55	60	NOT	NOT	NOT
30	2219	NOT	63	70	NOT	NOT	NOT
SUM	43871	N.A.	-	-	-	-	-
AVG	1462	N.A.	63	66	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.

@ DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT THERMODYNAMIC CONVERSION EQUIPMENT

SITE: ALARAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-70/04
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000
6	0.005	0.083	0.002	0.003	0.058
7	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000
SUM	0.005	0.092	0.002	0.003	0.058
AVG	0.000	0.003	0.000	0.000	0.002

* DENOTES UNAVAILABLE DATA.

2 DENOTES NULL DATA.

N.A. DENOTES NOT APPLICABLE DATA.

NOTE:

SCLAP HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT AUXILIARY STORAGE PERFORMANCE

SITE: ALARAMA POWER COMPANY, MONTEVALL, AL SOLAP/2017-79/04
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	INCREASE IN STORAGE ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.105	0.000	0.000	46	1.000
2	0.000	0.658	-0.199	45	0.302
3	0.040	0.210	-0.026	45	0.068
4	0.071	0.222	-0.000	45	0.358
5	0.000	0.195	-0.006	44	0.029
6	0.000	0.272	-0.020	44	0.074
7	0.053	0.000	0.089	45	1.000
8	0.023	0.000	0.117	47	1.000
9	0.023	0.136	-0.256	45	2.046
10	0.000	0.217	-0.009	45	-0.040
11	0.085	0.422	-0.075	44	-0.414
12	0.001	0.243	-0.145	45	-0.594
13	0.029	0.298	-0.040	45	0.267
14	0.027	0.000	0.002	45	1.000
15	*	0.000	0.100	47	1.000
16	*	*	*	*	*
17	*	*	*	*	*
18	*	*	*	*	*
19	0.120	0.235	0.057	44	0.269
20	0.018	0.388	-0.080	44	0.254
21	0.020	0.000	0.106	44	1.000
22	0.139	0.000	0.063	46	1.000
23	0.088	0.411	-0.089	45	0.430
24	0.109	0.350	0.016	45	0.282
25	0.159	0.187	0.131	45	0.114
26	1.182	0.000	1.365	56	0.000
27	0.574	0.040	1.060	67	12.772
28	0.044	0.000	0.026	65	1.000
29	0.000	0.000	-0.000	65	1.000
30	0.043	1.533	-1.268	53	0.855
SUM	3.240	6.685	0.448	-	-
AVG	0.111	0.223	0.015	48	0.433

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT AUXILIARY THERMODYNAMIC CONVERSION EQUIPMENT

SITE: ALABAMA POWER COMPANY, MONTEVALLO, AL SOLAR/2017-70/04
REPORT PERIOD: APRIL, 1970

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REFLECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	0.000	0.000	1.358	0.000	0.000
2	2.749	0.815	1.823	2.743	3.372
3	1.674	0.590	1.860	1.740	2.792
4	1.732	0.594	1.920	1.757	2.915
5	1.707	0.588	1.924	1.774	2.903
6	1.814	0.608	1.927	1.866	2.984
7	0.000	0.000	1.637	0.000	0.000
8	0.000	0.000	1.874	0.000	0.000
9	1.512	0.527	1.874	1.551	3.866
10	1.937	0.640	1.940	2.015	3.027
11	2.951	0.828	1.986	2.805	3.566
12	2.114	0.696	1.964	2.148	3.037
13	1.987	0.598	1.867	1.876	3.154
14	0.000	0.000	1.637	0.000	0.000
15	0.000	0.000	1.637	0.000	0.000
16	*	*	*	*	*
17	*	*	*	*	*
18	*	*	*	*	*
19	2.074	0.696	2.055	2.135	2.977
20	2.342	0.672	1.931	2.326	3.483
21	0.000	0.000	1.637	0.000	0.000
22	0.804	0.296	1.738	0.783	3.718
23	2.452	0.760	1.977	2.476	3.228
24	2.348	0.785	2.015	2.401	2.991
25	1.564	0.562	1.790	1.626	2.785
26	0.079	0.000	1.716	-0.101	0.000
27	1.259	0.273	1.937	1.106	4.613
28	0.000	0.000	1.637	0.000	0.000
29	0.000	0.000	1.637	0.000	0.000
30	3.930	1.040	1.905	3.939	3.788
SUM	41.042	12.865	54.503	41.173	-
AVG	1.368	0.429	1.817	1.372	3.190

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.
NOTE:

UNIVERSITY OF FLORIDA



3 1262 09052 6947